Non-Competition Covenants in Employment Agreements with Litigation Uncertainty *

Alcino Azevedo[†], *Paulo J. Pereira*[‡] *and Artur Rodrigues*[§]

[†]*Hull University Business School, University of Hull*

[‡]*CEF.UP and Faculdade de Economia, Universidade do Porto.*

[§]*NIPE and School of Economics and Management, University of Minho.*

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Abstract

This paper presents a real option model which evaluates the effect of non-competition covenants on the ex-ante behaviour of employers and employees, regarding the negotiation of the covenant, and ex-post behaviour of employees, concerning the termination of the employment and the violation of the covenant. Among other results, we show that there is an infinite number of pairs of "time-period of the covenant" *versus* "severance payment" that makes optimal for the employee to terminate the employment, and that these two variables largely determine the behaviour of the employee, regarding the termination of the employment, and the behaviour of the employer, concerning the reimbursement to be claimed if there is an illegal violation of the covenant. In addition, we find that firms from more volatile industries should claim higher reimbursements and that there is a cut-off range for the industry volatility which makes the reimbursement significantly more expensive if it is crossed. We also show that the employee's optimal threshold to leave the employement becomes less sensitive to the period of embargo of the covenant as the industry volatilty increases. We provide other sensitivity analyses which show optimal, nonlinear and complex employer-employee behaviour criteria associated with non-competition covenants.

Keywords: Employment Contract, Labor Law, Litigation, Non-Competition Covenant, Real Options, Uncertainty.

JEL codes: J53, J80, K31, K33, K42.

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1 Introduction

"The former employee who departs with confidential business information is the most exasperating of all competitors" (Belmont Laboratories, 1939). For most firms, the human capital of their employees is a core asset, but it is one over which they cannot exercise ownership (Garmaise (2009)). Non-competition covenants (NCCs) in employment agreements are contracts which protect firms' confidential business information from their former employees whose departure raises the threat of unfair competition. The use of NCCs became increasingly popular to guard against the risk of losing confidential information to competitors after the termination of an employment.

In this paper, "confidential business information" means any item or knowledge not generally known in trade or industry that is used in the conduct of a firm, the use of which confers a competitive advantage over the firms which do not possess it.[1] A typical NCC recites that after termination of an employment for any reason, the employee will not work in the same or similar line of business activity, either for herself or for anyone else within a designated geographical area for a specified period of time (see Hutter (1981)).

More recently, in a variety of industries, employers started imposing NCCs to potential employees as a condition for offering some jobs, and this is an increasingly more common practice not only in the information technology (IT) industry, but also in other industries such as the insurance, banking and law, and even in less-skilled knowledge industries such as the hairdressing (Kräkel and Sliwka (2009)).[2] The use of NCCs in employment agreements is partly a function of the probability of the existence of opportunistic behaviors in an employer-employee relationship. The greater the probability of particular types of opportunism, the greater is the need for monitoring and control of such behaviors and, therefore, the use of NCCs (see Barney et al. (1994)).

A NCC has value for the employer because it protects sensible business information from competitors during the time-period of the covenant, and "destroys" value for the employee, because, over the time-period of the covenant, she is not allowed to work for competitors of her former employer, where her knowledge and expertise are more appreciated and, therefore, she could earn a higher salary. Consequently, a "fair" negotiation of a NCC should include a severance payment to the employee which (at least) offsets the salary she expects to lose if her employment terminates and she undertakes the covenant.

The law literature on NCCs is very extensive (see, among others, Hutter (1981), Gilson (1999), Hardaway (2016), Callahan (1985), Anenson (2005),Bishara and Orozco (2012), Mack (2015), and Horvitz (2015)). The economics literature also studies NCCs, for instance, their effect on the labor market mobility and innovation (see, e.g., Den Hertog

[1] For instance, trade secrets, goodwill embedded in customer lists and other intangible assets.

[2] The following article published in the New York Times illustrates how this phenomenon is increasingly more common across different industries: http://www.nytimes.com/2014/06/09/business/noncompete-clauses-increasingly-pop-up-in-array-of-jobs.html.

(2003), Garmaise (2009), Kräkel and Sliwka (2009), Perri (2010) Marx et al. (2009), Marx (2011), Mawdsley and Somaya (2015) and Tang et al. (2016)). But, to our best knowledge, the finance literature on the evaluation of NCCs is yet nonexistent.

However, the use of NCCs is increasingly popular in countries with advanced economies, and empirical evidence suggests that these often play an important role in the economic development. It is argued that the advantages of the use of NCCs to the public are the protection of proprietary interests, facilitation of investments in R&D and encouragement of human capital (personnel) development, and the disadvantages are the potential of limiting competition (impeding the dissemination of information) and retarding the economic mobility of employees (see Anenson (2005)).

For instance, Gilson (1999) and Hyde (2003) suggest that one of the main reasons for the success of the high technology industrial district in Silicon Valley and the failure of the one in Massachusetts' Route 128 was the differential enforcement of covenants not to compete. The different legal environments led to higher employee turnover and, therefore, more firms in California (see also Bishara and Orozco (2012) and Buente (2012)). In addition, Conti (2014) investigates the effect of NCCs on the type of R&D activity firms undertake, using a dataset on the US patent applications, and conclude that these reduce the outbound mobility and knowledge leakages to competitors and, consequently, make the high-risk R&D projects relatively more valuable than the low-risk ones, inducing firms to choose riskier R&D projects.

On the other hand, it is common some employees to breach their NCCs contending that they are illegal and these claims being considered admissible in courts.[3] A well-known case of a NCC breach is that which involved Dr. Kai-Fu Lee, a renowned well-connected computer scientist and former worker of Microsoft in China, who was later appointed president of Google in China and, shortly after, Microsoft revealed that he was subject to a NCC. Microsoft immediately went to court in Seattle, Washington, and the court issued a restraining order forbidding temporarily Dr. Lee to work on projects for Google similar to those he performed for Microsoft.[4],[5] The fear of workers being poached caused some large IT firms, including Google, Apple, Yahoo and Genentech, to informally agree not to hire workers from firms they view as partners (see Helfdt (2009b) and Helfdt (2009a).[6].

Courts have tended to see NCCs unfavorably (see, e.g., Callahan (1985)). For instance, some US states, such as California, Alabama and Alaska, forbid the use of NCC, and Texas

[3]The typical litigation case concerns competitor suing competitor after one business hires the employee of the other in apparent violation of the NCC (see Anenson (2005)).

[4]In 2000, Dr. Lee had signed an agreement providing that, for a period of one year after leaving Microsoft, he would not "accept employment or engage in activities competitive with products, services, or projects... on which [he] worked or about which [he] learned confidential or proprietary information or trade secrets while employed at Microsoft."

[5]For further details see also: Bakerand Hosteller LLP Executive Alert, September 2005.

[6]For further information see: http://www.nytimes.com/2009/06/03/technology/companies/03trust.html? and http://www.nytimes.com/2009/06/04/technology/companies/04trust.html?

and Michigan have restricted their use (see Den Hertog (2003)) and, in the UK, to avoid litigancy and litigancy uncertainty, in 1986, some firms started using, as an alternative to NCCs, the so-called garden leave (GL) provisions. A GL has a similar restriction regarding working for a competitor, and may prevent an individual from working at all, but during the time-period of the GL the worker is paid full salary (including benefits) by her (soon to be) ex-employer.[7] Klein and Pappas (2009) reports that the UK courts have consistently supported employment contracts with a GL and are less supportive of employment contracts with a NCC. It has been suggested that many US firms also started relying more on GL agreements and less on NCC agreements because the former contract is more likely to be enforceable.

Employees can sign a NCC when hired, after being hired, when leaving, or never, depending on the situation. Yet, if a NCC is to be signed, both the employer and the employee should study very carefully the terms of the covenant so as to be enforceable. According to (Gaby Hardwicke Solicitors 2011), one of the main reasons NCCs are considered illegal in the US is because of the "unnecessarily" long time span of the agreement. Indeed, courts try to inquire whether NCCs are socially and economically "reasonable" but, as there is not yet a consensual theoretical framework to objectively identify and assess the "legitimacy" of the employer-employee competing interests, so the decisions are very unpredictable (Bitė (2011)).

This paper provides a real option model which evaluates the competing economic interests of employers-employees regarding NCCs. Our results can have relevant implications at various levels. At the firm-employee level, because it turns easier the negotiation of "fairer" NCC agreements, at the economic level, because it provides a guideline for the development of more sophisticated labor laws and rules considering NCCs, at the judicial level, because it is the first financial model, based on a solid theoretical background, that evaluates the competing economic interests underlying NCCs and, therefore, provides a theoretical framework to guide courts to judge whether NCC breaches are justified or not.

The rest of the paper is organized as follows. Sections 2 presents the model and provides the results of a sensitivity analysis. Section 3 considers the scenario where the manager violates the covenant agreement, and there is litigation. Section 4 concludes.

2 The Model

2.1 The manager's perspective

Consider a market with two active firms, i and j, and a manager who works for firm i with a salary defined as a percentage of the market's profits. In addition, define the value of firm i, V_i, as a multiple of the normalized stock of capital $K_i = K_j = 1$ and a state

[7] That is, the worker is to some extent on a "paid vacation".

variable X (i.e., $V_i = K_i X$ and $V_j = K_j X$), and evolving randomly over time according to a geometric Brownian motion (GBM) process, given by:

$$dX = \alpha X dt + \sigma X dW \tag{1}$$

where α, σ, and dW are, respectively, the drift under the risk-neutral measure, the volatility, and the increment of a Wiener process.

Furthermore, assume that the manager's salary is given as a percentage of the market's profits, therefore, a multiple of the state variable X, and define w_i as the percentage of the market's profits which corresponds to the manager's salary if she works for firm i. Thus, if the managers works for firm i her salary is given by $w_i X$.

In addition, assume that firm i is afraid that, in the near future, the manager might be tempted to terminate her employment contract and start working for a competitor, firm j. This is a problem because, currently, the manager holds valuable business information which, if shared with firm j, will lead to a profit loss for firm i and a profit gain for firm j. Let define this profit loss/gain by a factor $\theta \in (0, 1)$ and assume that the two firms play a zero-sum game. Therefore, the profit loss of firm i corresponds to the profit gain of firm j.

To prevent the above profit loss, firm i negotiates a NCC with the manager which forbids her from working for firm j, over a given time period, T, if her employment terminates. Any constrain on the employment contract of the manager that reduces her flexibility to act as she wishes after leaving firm i, reduces the value of the "option to leave". Hence, the manager should only accept a NCC if firm i agrees to pay her a severance payment which (at least) offsets the fall in value of the option to leave.

Suppose that both the firm and the manager agree with a NCC and the manager leaves firm i (say time, $t = 0$), undertaking the covenant. Let assume that the profits loss of firm i, associated with the termination of the employment, decreases over the time-period of the covenant, T. More specifically, assume that if the employment terminates and the manager starts working immediately for firm j, the profit loss of firm i is given by a factor θ, and reaches a maximum, whereas if the manager terminates her employment and starts working for firm j not immediately, but within the period of embargo of the covenant (violating the covenant), the profit loss of firm i is given by $\theta e^{-\lambda t}$, where λ captures the rate of profits loss decrease with time.

Assume that the employment terminates and the manager undertakes the covenant, re-entering the industry only after the period of embargo, and that the present value of the manager's salary from working outside the industry, during the period of embargo, is given by W. The maturity of the covenant is finite, therefore, over the period of embargo of the covenant (after leaving firm i), the manager holds a "forward-start option" to re-enter the industry, which she can exercise as soon as T is reached, if it is optimal to do so.

Finally, assume that, if the manager re-enters the industry after the period of embargo of the covenant, her salary is given by $w_j X$.

Note that the profit loss(gain) of firm $i(j)$ and the manager's salary over time depend on the state variable X, which fluctuates randomly. Therefore, the optimal time to exercise the forward-start option also depends on the state variable X, and is not known ex-ante.

Our timing optimization problem comprises three stages which we illustrate below.

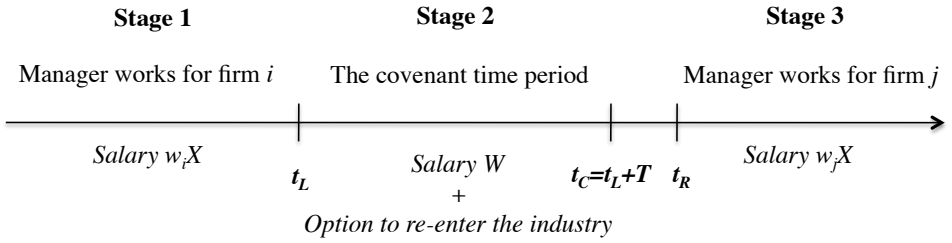

Figure 1: Stages of the Timing Optimization Problem.

Where t_C represents the time in which the period of embargo of the covenant terminates, t_L is the optimal time to leave firm i, t_R is the optimal time to start working for firm j (re-enter the industry), and T is the period of embargo of the covenant. For simplicity of the illustration we set $t_R > t_C$, although $t_R = t_C$ is also possible if the optimal time to start working for firm j coincides with that in which the period of the embargo of the covenant terminates.

To solve the above optimization problem we follow a standard backwards-induction procedure, where we start by the timing optimization of the last stage, t_R (time to start working for firm j) and then work backwards until the timing optimization the first stage (time to leave firm i).

Using a contingent-claim framework, the option to re-enter, $R(X)$, must satisfy the following ordinary differential equation:

$$\frac{1}{2}\sigma^2 X^2 R_{XX}(X) + \alpha X R_X(X) - rR(X) = 0 \tag{2}$$

whose general solution is given by:

$$R(X) = A_1 X^{\beta_1} + A_2 X^{\beta_2} \tag{3}$$

where A_1 and A_2 are arbitrary constants to be determined, and β_1 and β_2 are, respectively, the positive and the negative roots of the following characteristic quadratic equation:

$0.5\sigma^2\beta(\beta-1)+\alpha\beta-r=0$, given by:

$$\beta_1=\frac{1}{2}-\frac{\alpha}{\sigma^2}+\sqrt{\left(\frac{\alpha}{\sigma^2}-\frac{1}{2}\right)^2+\frac{2r}{\sigma^2}}>1 \tag{4}$$

$$\beta_2=\frac{1}{2}-\frac{\alpha}{\sigma^2}-\sqrt{\left(\frac{\alpha}{\sigma^2}-\frac{1}{2}\right)^2+\frac{2r}{\sigma^2}}<0 \tag{5}$$

The value of the option to re-enter the industry increases as X decreases, therefore, we must set $A_2=0$. The optimal time to re-enter the industry (t_R) is defined according to:

$$t_R=inf\{t\geqslant t_C : X(t)\geqslant X_R\} \tag{6}$$

where t_C is the time in which the period of embargo of the covenant terminates, and X_R is the optimal threshold to re-enter the industry.

Ignoring the effect of the NCC, the constant A_1 and the optimal threshold to re-enter the industry, X_R, are determined using the so-called value-matching and smooth-pasting conditions, Equations (7) and (8), respectively:

$$A_1(X_R)^{\beta_1} = w_j(1+\theta e^{-\lambda T})X_R-W \tag{7}$$

$$\beta_1 A_1(X_R)^{\beta_1-1} = w_j(1+\theta e^{-\lambda T}) \tag{8}$$

In Eq. (7), the term in the left-hand side represents the value of the option to re-enter the industry, and the first and the second terms in the right-hand side represent the manager's salary if she re-enters the industry at T and the manager's salary if she works outside the industry, respectively. The value of the option to re-enter the industry is given by:

$$R(X)=\begin{cases}(w_j(1+\theta e^{-\lambda T})X_R-W)\left(\dfrac{X}{X_R}\right)^{\beta_1} & \text{for } X<X_R\\ w_j(1+\theta e^{-\lambda T})X-W & \text{for } X\geqslant X_R\end{cases} \tag{9}$$

with

$$X_R=\frac{\beta_1}{\beta_1-1}\frac{W}{w_j(1+\theta e^{-\lambda T})} \tag{10}$$

At the beginning of Stage 2, the option to re-enter the industry is equivalent to a

forward-start option whose value is given by:[8]

$$F(X,T) = w_j(1+\theta e^{-\lambda T})Xe^{-(r-\alpha)T}N\left(d_1(X,T)\right) - We^{-rT}N\left(d_2(X,T)\right) \\ +(w_j(1+\theta e^{-\lambda T})X_R - W)\left(\frac{X}{X_R}\right)^{\beta_1} N\left(-d_3(X,T)\right) \tag{11}$$

where $N(.)$ is the cumulative normal integral, and

$$d_1(X,T) = \frac{\ln\left(\frac{X}{X_R}\right) + \left(\alpha + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} \tag{12}$$

$$d_2(X,T) = d_1(X,T) - \sigma\sqrt{T} \tag{13}$$

$$d_3(X,T) = d_1(X,T) + (\beta - 1)\,\sigma\sqrt{T} \tag{14}$$

In the right-hand side of Eq. (11), the first two terms represent the value of the forward-start option for the manager if her re-entry threshold, X_R, is reached before the period of embargo of the covenant terminates. It is equivalent to the value of an European option on a dividend paying asset with maturity T that is exercised at T if $X(T) \geqslant X_R$. The last term captures the option value if, at the maturity of the covenant (T), the threshold X_R has not yet been reached.

Let analyze now the optimization problem at Stage 1, where the manager works for firm i, with a salary w_iX, and holds the option to leave. The timing optimization of the exercise of this option should consider that, over the period of embargo of the covenant, the manager will be forced to work outside the industry, earning a lower salary W (i.e., $W < w_iX$). The value-matching and smooth-pasting conditions regarding the option to leave, $L(X,T)$, are given by Eqs. (15) and (17), respectively, where X_L is the optimal threshold to leave:

$$B_2(X_L)^{\beta_2} = C + W + F(X_L,T) - w_iX_L - (w_j - w_i)X_L - w_j\theta X_L \tag{15}$$

$$= C + W + F(X_L,T) - w_j(1+\theta)X_L \tag{16}$$

$$\beta_2 B_2(X_L)^{\beta_2 - 1} = F_X(X_L,T) - w_j(1+\theta) \tag{17}$$

The interpretation of the Eqs. above is the following. Before leaving firm i the manager has the option to leave whose value is given by the left-hand side of Eq. (15). This option should be exercised as soon as its value equals that which is represented by the terms in the right-hand side, where C is the severance payment to be paid to the manager for the covenant, W is the manager's salary from working outside the industry, $F(X_L,T)$ is the value of the forward-start option, w_iX_L is the manager's salary from working for firm i

[8] For further details on the intricacies of the analytical derivations of the forward-start option, see Shackleton and Wojakowski (2007) and Pereira and Rodrigues (2014).

(which she loses if she leaves) and $(w_j - w_i)X_L$ and $w_j\theta X_L$ represent two opportunity costs in which the manager incurs if she defers the option to leave, respectively: a loss in salary because firm j pays her a higher salary and a loss in salary associated with the value she adds to firm j (given by θ).

The value of the option to leave firm i is given by:

$$L(X,T) = \begin{cases} C + W + F(X,T) - w_j(1+\theta)X & \text{for } X < X_L \\ (C + W + F(X_L,T) - w_j(1+\theta)X_L)\left(\dfrac{X}{X_L}\right)^{\beta_2} & \text{for } X \geqslant X_L \end{cases} \tag{18}$$

The optimal threshold to leave, X_L, has a numerical solution given by:

$$\beta_2(C + W + F(X_L,T) - w_j(1+\theta)X_L) - F_X(X_L,T)X_L + w_j(1+\theta) = 0 \tag{19}$$

2.2 Comparative Statics

Figure 2 shows the effect of the severance payment, C, on the optimal threshold to leave firm i, for different periods of embargo of the covenant, T. It reveals that the threshold to leave increases with the severance payment and decreases with the period of embargo. Therefore, managers leave later as the severance payment increases and the period of embargo of the covenant decreases.

[Insert Figure 2 here]

Figure 3 presents the effects of σ, W, w_j, θ and λ on the threshold to leave firm i, for different values of T and C. More specifically, figures 3(a) and 3(b) show that the threshold to leave decreases with the volatility of the state variable. Therefore, the manager leaves later if σ increases. This result is in line with the usual results from a real option model, which advocates that uncertainty delays decisions, and suggests that, regardless of the period of embargo of the covenant and the severance payment, the manager leaves her current employment later when profits uncertainty is higher. Interestingly, we also find that as σ increases the threshold to leave becomes less sensitive to changes in T, which means that increases in the period of embargo of the covenant are less likely to change managers behaviour regarding the termination of an employment if these work in more volatile industries.

Figures 3(c) and 3(d) show that the threshold to leave firm i varies with W in a non-monotonic way, and that this pattern holds for different values of T and C. More specifically, for lower levels of W, it increases with W, for moderate leves of W, it decreases with W, and for higher levels of W, it increases with W. Note that W is the manager's salary from working outside the industry. Therefore, we conclude that the manager's salary from working outside the industry play an important role in the manager's optimal

time to leave firm i, but the direction of the effect of W on the threshold to leave depends on the current level of W. Furthermore, we find that the threshold to leave firm i decreases with T and increases with C.

Figures 3(e) and 3(f) show that the manager's threshold to leave firm i increases with C, decreases significantly with W_j, and is only very marginally affected by changes in T. Note that w_j is the manager's salary after re-entering the industry. Therefore, taken these results together, we conclude that the expectation of the manager regarding her salary from working for firm j (after the period of embargo of the covenant) play a very important role in the timing optimization of her decision to leave firm i. More specifically, the higher the manager's salary from working for firm j the later she leaves firm i. This is because by leaving firm i the manager incurs in an opportunity cost, given by $W - w_j < 0$, since during the period of the covenant she is not allowed to work for firm j where she would earn a higher salary. *Ceteris paribus*, the higher the w_j the higher is the opportunity cost.

Figures 3(g) and (3h) show that the threshold to leave firm i decreases with both θ and T, and increases with C. Note that θ is the loss (gain) for firm i (j) associated with the leaving (re-entering) of the manager from (to) the industry. used to the current employer as a consequence of the termination of the employment, the later the employment terminates. We find that the higher the loss (gain) to the current (future) employer the later the manager leaves, if she shares part of the value she adds to the future employer but is only allowed to do so after a period of embargo. Our results also reveal that the current employer can inhibit further the leaving of the manager through the use of a covenant with a longer period of embargo and or a higher severance payment. This result is interesting because it provides a guideline for employers regarding how they can affect the career management of employees whose leaving can cause significant profits losses.

Figures 3(i) and 3(j) show that the faster the losses (gains) to firm i (j) decrease with time (λ), the later the manager leaves firm i. This is an interesting result because it shows that a higher rate of erosion of the value fo the knowledge of the manager with time delays her leaving. We show that the perceptions of the employer and the employee regarding how rapidly knowledge erodes with time, determine to some extent the severance payment and the period of embargo of the covenant.

[Insert Figure 3 here]

Figure 4 shows the effect of the period of embargo of the covenant (T) on the severance payment (C) that turns leaving firm i optimal. We provide this analysis for various levels of X, σ, W, w_j, θ and λ, and show that C increases with T regardless of the values used for X, σ, W, w_j, θ and λ. We also show that C increases with X, σ, w_j, θ, and λ, for the whole range of values used for T (see Figures 4(a), 4(b), 4(d), 4(e) and 4(f), respectively), but the effect of W on C, as T increases, is undetermined (see figure 3(c)).

More specifically, for relatively lower T , C increases with W, whereas for higher T, C decreases with W.

[Insert Figure 4 here]

3 Early Re-Entry and Litigation

In this section we analyze the case where the manager leaves firm i and violates the NCC, contending that it is illegal. A typical NCC litigation case concerns competitor suing competitor after one business hires the employee of the other in apparent violation of the NCC underlying the employment contract. Note that this scenario is more likely if, while working outside the industry, during the period of embargo of the covenant, the state of the industry in which the manager is knowable improves significantly.

Consider that at a give time, t, the manager undertakes the covenant. If so, over the period of embargo (for $t < T$), the value of firm i is given by:

$$H^R(X,(T-t)) = -\theta X e^{-(r-\alpha+\lambda)(T-t)} N\left(d_1(X,T)\right) - \theta e^{-\lambda T} X_R \left(\frac{X}{X_R}\right)^{\beta_1} N\left(-d_3(X,T)\right) \tag{20}$$

Note that firm i is short in a (the manager's) forward-start option with maturity $(T-t)$ years. Therefore, in the right-hand side of Eq.(20), the first term captures the loss in value for firm i if the manager's threshold to re-enter the industry (i.e., to start working for firm j) is reached before or at T, and the second term represents the loss for firm i if, at T, the manager's threshold to re-enter the industry has not yet been reached. Note that the exercise of the option to re-enter the industry is conditioned on two facts: T being reached and the manager's optimal threshold to re-enter the industry being triggered. If, at T, it is optimal to re-enter the industry, the manager starts working immediately for firm j, otherwise she defers the decision until the optimal re-entering threshold is reached.

Consider now that the manager violates the covenant and re-enters the industry before T. In this scenario, the value of firm i deteriorates according to:

$$H^{NR}(X,t) = -\theta e^{-\lambda t} X \tag{21}$$

If there is litigation (i.e., firm i goes to court), the appropriate reimbursement to be paid by the employee to firm i, for the violation of the covenant if it is considered illegal, is given by:

$$R(X,(T-t)) = max\left[H^{NR}(X,t) - H^R(X,(T-t)), 0\right] \tag{22}$$

Our model advocates that the reimbursement to be paid by the employee to the employer is determined by the difference between the loss in value for the employer now,

due to the violation of the covenant, and the loss in value in future, if the covenant is undertaken. Note that the reimbursement is positive because, we assume that, in case the violation of the covenant is considered legal, the firm will not have to pay the employee.

3.1 Comparative Statics

Figure 5 shows the effect of T, σ, W, w_j, θ and λ on the reimbursement (R_b) to be paid by the employee to the firm, as a consequence of the violation of the covenant, for different values of $T-t$, where $T-t$ represents the time to the maturity of the covenant. More specifically, figures 5(a) shows that the effect of T on R_b is not monotonic. For relatively low values of T, R decreases with T, whereas for relatively high values of T, R_b increases with T. Figure (5b) reveals that R_b increases with σ but there is a range of (moderate) values of σ for which R_b is very sensitive to changes in σ and a range of (either extremely high or extremely low) values of σ for which R_b is not very sensitive to changes in σ. This results is interesting because it shows that, *ceteris paribus*, the reimbursement is significantly affected by the nature of the industry where the manager works. More volatile industries should claim higher reimbursements if the covenant is violated illegally.

Figures 5(c) and 5(d) show that R_b increases with W and decreases with w_j, respectively. In addition, we find that R_b is significantly more sensible to changes in each of these variables if their values are moderate. Figures 5(e) and (f) show that R_b increases with θ and decreases with λ. This means that the higer the loss caused by the manager to the employer, when she leaves the firm, the higher is the reimbursement to be claimed by the employer if the employee violates the covenant.

Finally, we find that R_b decreases with the time to the maturity of the covenant ($T-t$), regardless of the values of T, σ, W, w_j, θ and λ . Hence, the reimbursement associated with the violation of the covenant decreases as the time in which the violation occurs gets closer to the maturity of the covenant.

[Insert Figure 5 here]

4 Conclusion

This paper presents a real option model which evaluates the effect of NCCs on the ex-ante behaviour of employers and employees, regarding the negotiation of the covenant, and the ex-post behaviour of employees concerning the termination of the employment and the violation of the covenant. It applies to cases where firms want to protect their business confidential information from former employees whose departure raises the threat of unfair competition, and considers that, before the termination of the employment, the employee holds the "option to leave", which has value if there is salary uncertainty.

Our model provides guidelines for optimal behaviour criteria related to NCCs. For instance, we find that there is a period of embargo of the covenant which minimizes the reimbursement to be paid by the employee if there is an illegal violation of the covenant, and an infinite number of pairs of "period of embargo of the covenant" *versus* "severance payment" which makes optimal the termination of the employment, and that these two variables largely determine the behaviour of the employee, concerning the termination of the employment and the violation of the covenant, and the behaviour of the employer, regarding the reimbursement to be claimed if there is a violation of the covenant.

We find that the reimbursement to be paid to the employer, if there is an illegal violation of the covenant, is significantly affected by the nature of the industry. Firms from more volatile industries should claim higher reimbursements. There is a cut-off range for the volatility values which makes reimbursements significantly more expensive if it is crossed.

We also show that the expectation of the employee regarding the depreciation of her knowledge with the time-period of the covenant affects significantly her optimal time to leave the employment. The more rapidly knowledge depreciates with time, the later she leaves. This is an interesting result because it shows that the perceptions of the employer and the employee, regarding how rapidly knowledge depreciates with time, determines, to some extent, the severance payment and the period of embargo of the covenant.

We provide other sensitivity analyses which show nonlinear and complex employer-employee behaviour criteria associated with the use of NCCs.

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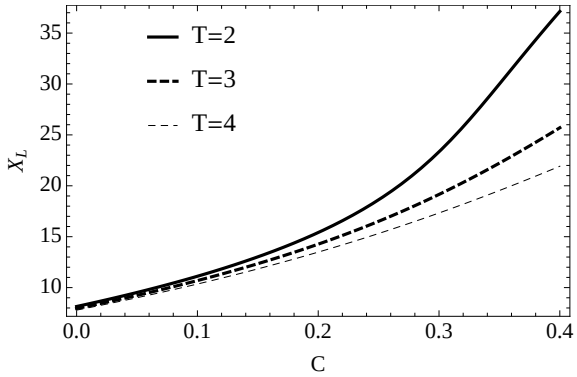
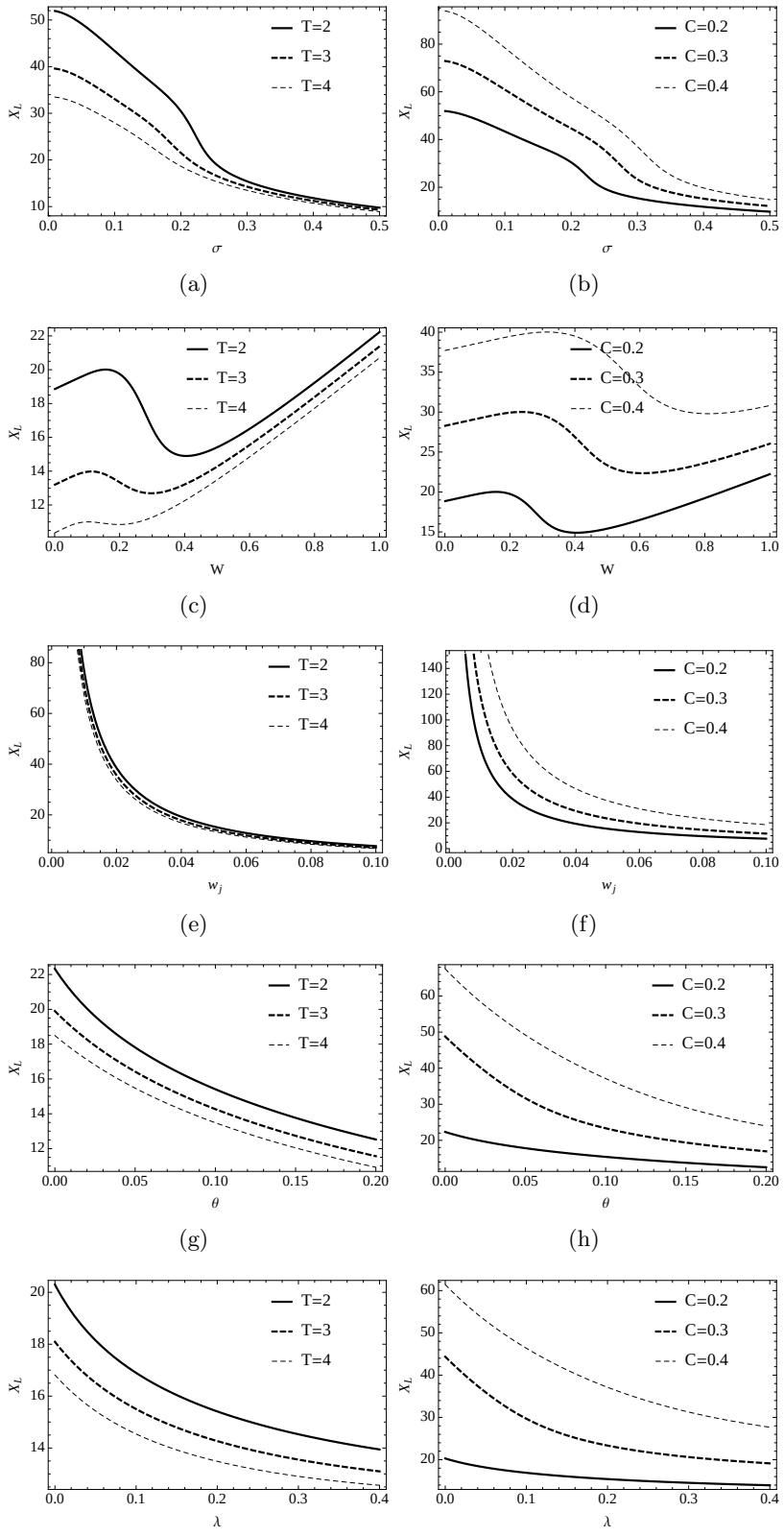
Figures



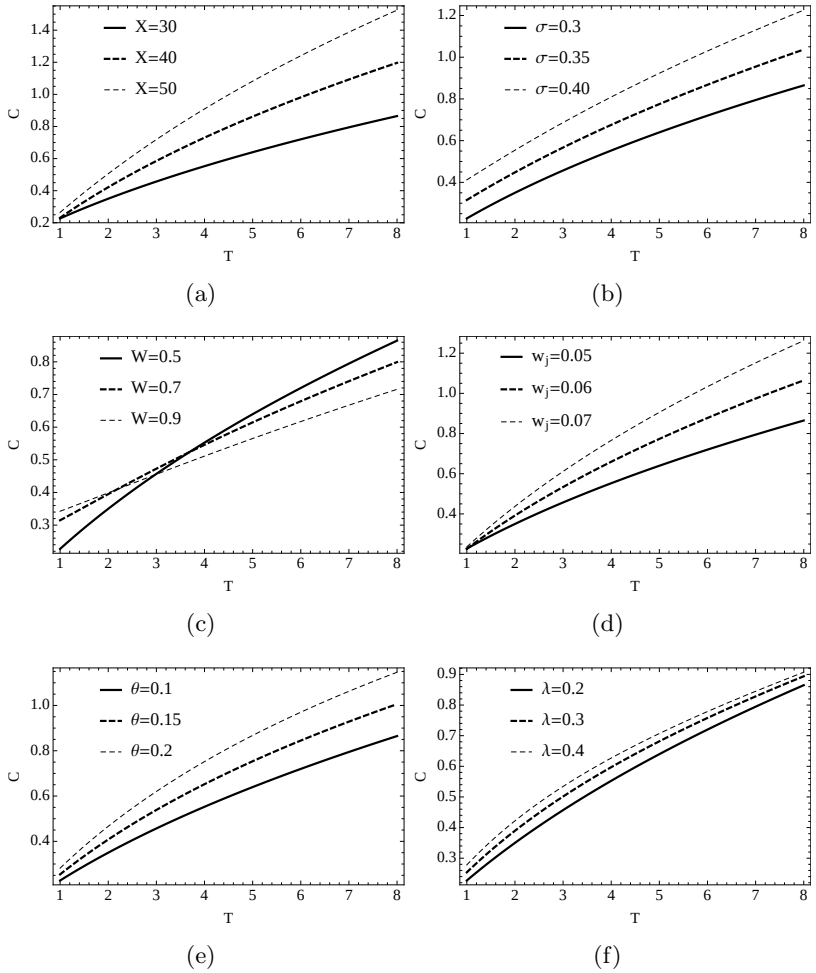
$\sigma = 0.3$, $r = 0.05$, $\alpha = 0.02$, $W = 0.5$, $w_j = 0.05$, $\theta = 0.1$, $\lambda = 0.2$.

Figure 2: Effect of the severance payment and the period of embargo of the covenant on the optimal threshold to leave firm i.



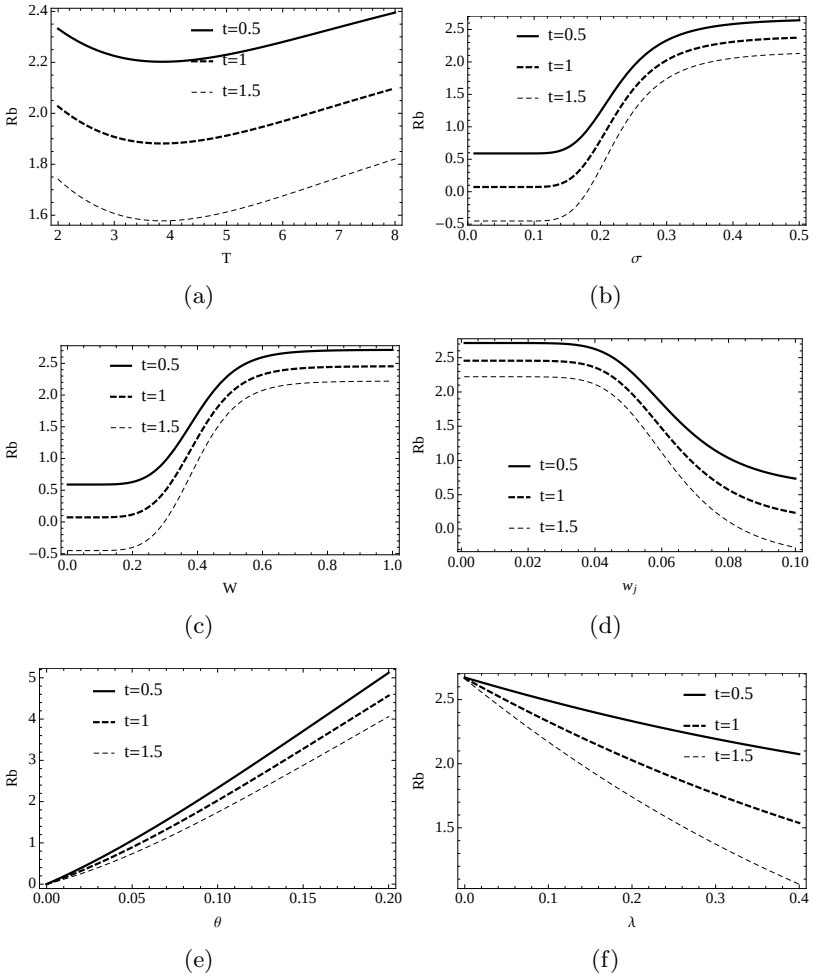
$\sigma = 0.3$, $r = 0.05$, $\alpha = 0.02$, $W = 0.5$, $w_j = 0.05$, $\theta = 0.1$, $\lambda = 0.2$.

Figure 3: Comparative statics of the effect of the model parameters on the optimal threshold to leave firm i.



$X = 30, \sigma = 0.3$, $r = 0.05$, $\alpha = 0.02$, $W = 0.5$, $w_j = 0.05$, $\theta = 0.1$, $\lambda = 0.2$.

Figure 4: Comparative statics of the effect of the model parameters on the severance payment to be paid (claimed) to (by) the manager.



$T = 2$, $\sigma = 0.3$, $r = 0.05$, $\alpha = 0.02$, $W = 0.5$, $w_j = 0.05$, $\theta = 0.1$, $\lambda = 0.2$.

Figure 5: Comparative statics of the effect of the model parameters on the reimbursement to the firm if there is litigation.